OIPE
DEC 30 2006
PATENT & TRADEMARK OFFICE
IAP92

APPLICATION NO. 10/772,597

TITLE OF INVENTION: Decisioning rules for turbo and convolutional decoding

NVENTORS: Urbain A. von der Embse

DRAWINGS AND PERFORMANCE DATA

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01-03-07

PTO/SB/21 (09-04)
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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	10/772,597
Filing Date	02/06/2004
First Named Inventor	Urbain A. von der Embse
Art Unit	2133
Examiner Name	Stephen M. Baker
Attorney Docket Number	

Total Number of Pages in This Submission

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
- ☐ Fee Attached
- ☒ Amendment/Reply
- ☐ After Final
- ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
- ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
- ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please Identify below):

Remarks

Reply to Office Action 10/02/2006

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name			
Signature	Urbain A. von der Embse		
Printed name	Urbain A. von der Embse		
Date	12/28/2006	Reg. No.	

CERTIFICATE OF TRANSMISSION/MAILING

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Signature	Urbain A. von der Embse		
Typed or printed name	Urbain A. von der Embse	Date	12/28/2006

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/772,597	02/06/2004	Urbain Alfred von der Embse		5182

7590 10/02/2006

Urbain A. von der Embse
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EXAMINER	
BAKER, STEPHEN M	
ART UNIT	**PAPER NUMBER**
2133	

DATE MAILED: 10/02/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary

Application No.	Applicant(s)	
10/772,597	VON DER EMBSE, URBAIN ALFRED	
Examiner	**Art Unit**	
Stephen M. Baker	2133	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 February 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 February 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5)☐ Notice of Informal Patent Application

6)☐ Other: _____.

DETAILED ACTION

Drawings

1. Figures 1-4, 7 and 8, despite the statement on page 29, lines 32-33, apparently should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

2. The disclosure is objected to because of the following informalities:

On page 1: in line 15 (all specification line numbers given are those indicated by applicant's margin numbering), "a-posterior" apparently should be "a-posteriori"; in line 19, "compexity" apparently should be "complexity"; in line 20, "BER" apparently should be "(BER)".

On page 2: line 1 apparently should be deleted; in lines 7-11, "Decisioning metrics DM currently used in turbo and convolutional decoding are the natural logarithm of the conditional Gaussian probabilities of the observed output symbol y at clock k

corresponding to the received codeword k, assuming that the transmitted symbol is x at k" is poorly worded, uses "k" to mean two different things by suggesting there is a codeword k rather than a codeword symbol (x(k)?) at time k, and apparently reverses the relationship between the received value, y, and the transmitted symbol, x, in the prior art "decisioning metric" by describing it essentially as ln p(y|x) instead of ln p(x|y) (for contrast, see, *e.g.*, equations 14, 19 and 35 of Hagenauer *et al* (ref. U) where the received signal value, y, is treated as a given quantity and the transmitted signal value $u_k = x$ is not; in line 23, in the formula for "DM(y,x)", the first minus sign remains in the term

"$-|x-y|^2/2\sigma^2$" despite that DM is apparently described as the "*negative* of the log (of the Gaussian) with the additive constant term removed" which apparently should be "$|x-y|^2/2\sigma^2$", in view of line 20; further regarding lines 21-23, it is noted that "σ" is treated as a constant, yet remains in the expression "$-|x-y|^2/2\sigma^2$" when "$2\sigma^2$" apparently could be scaled-out to leave "$-|x-y|^2$".

On page 5: in lines 9-12, "y(k)" is defined as being equal to "Output symbols for codeword k," as being equal to "{y(k,b)} where b refers to a codeword bit," which appears to disagree with the first definition, and as being equal to "{y(k), y(k), y(k)} for both #1 encoder and #2 encoder depending on the text," which is considered unclear and incorrect; in line 21, the same quantity, "y(k)," is further defined as being equal to "Output symbols for codeword/clock k," which appears to disagree with the first two definitions; in line 13, "y(k,b=1) = uncoded bit(s) in codeword k" is apparently

misdescriptive, incomplete and inconsistent as it apparently specifies a particular single bit value of one.

On page 6: in line 26, the equation for "p(s',s,y)" is apparently missing a close parenthesis at the end; in line 27, "p(y(j)>k|s',s,y(j<k),y(k))" apparently should be "p(y(j>k)|s',s,y(j<k),y(k))"; in line 31, "p(s',s,y) = p(y(j)>k|s) p(s',s,y(j<k),y(k))" apparently should be "p(s',s,y) = p(y(j>k)|s) p(s',s,y(j<k),y(k))"; in line 34, "p(s',s,y) = p(y(j>k)|s) p(s,y(k)|s') p(s',y(j<k))" apparently should be "p(s',s,y) = p(y(j>k)|s) p(s,y(k)|s',y(j<k)) p(s',y(j<k))"; in applying Bayes rule to line 31, *i.e.* p(s',s,y(j<k),y(k)) = p(a, b) {for a = (s,y(k)) and b = (s',y(j<k))} = p(a| b) p(b) = p(s,y(k)|s',y(j<k)) p(s',y(j<k)), it is not explained why the term "y(j<k)" is eliminated from the second term "p(s',y(j<k))".

On page 7: in line 7, "$\gamma_k(s,s')$ = p(s,y(k)|s')" apparently should be "$\gamma_k(s,s')$ = p(s,y(k)|s',y(j<k))", in view of the observation regarding line 34, above; regarding the equations for prior art $\alpha_{k-1}(s')$ = p(s',y(j<k)), $\beta_k(s)$ = p(y(j>k)|s) and $\gamma_k(s,s')$ = p(s,y(k)|s') in lines 6-8, it is noted here for later reference that all equations agree with $\alpha_{k-1}(s')$ = $p(s',y_{j<k})$, $\beta_k(s)$ = $p(y_{j>k}|s)$ and $\gamma_k(s,s')$ = $p(s,y_k|s')$ in Hagenauer *et al* (36).

On page 9: in line 5, "$\gamma_k(s, s')$ = p(s, y(k)| s')" apparently should be "$\gamma_k(s,s')$ = p(s,y(k)|s',y(j<k))", in view of the observation regarding line 34, above; in line 6, it's not clear how Bayes rule transforms "p(s,y(k)|s')" into "p(y(k)|s,s') p(s|s')".

On page 10: in line 14, "quadraturenoise" apparently should be "quadrature noise"; in line 18, "log $\underline{\gamma_k}(s,s')$ of $\gamma_k(s,s')$" apparently should be "log, $\underline{\gamma_k}(s,s')$, of $\gamma_k(s,s')$"; in line 19, "log $\underline{p}(d(k))$ of p(d(k))" apparently should be "log, $\underline{p}(d(k))$, of p(d(k))"; in lines 28 and 30, the underlining apparently should be deleted.

On page 16, in lines 25, 26 (two occurrences) and 30, "the new" apparently should be "a new," as the preceding part of the disclosure is limited to that which is old; in line 34, "paradyms" apparently should be "paradigms."

On page 17, in line 11, "ratio of the" apparently should be deleted.

On page 18, in lines 7 and 9, it's not understood why "f(x|y)" and "f(y|x)" are used instead of "p(x|y)" and "p(y|x)," and why it is suggested that "f(y|x)" is in any of the equations referred to as "equations 1"; in line 10, "*our* new MX" is not understood, as there is only one inventor listed for this application, and furthermore the specification should avoid using words such as "I" and the like; in line 15, "maximum a-posterior MX" apparently should be "maximum a-posteriori probability MX"; in line 16, "densify" is apparently supposed to be "density," however the meaning of "a-posteriori probability density function f(x|y) of x conditioned on the observation y, with respect to the selection of x" remains unclear; in lines 18-22, "Maximizing f(x|y) is equivalent to maximizing with respect to x, the natural log of f(x|y) equal to the new decisioning metric $DX=Re(yx^*)\sigma^2-|x|^2/2\sigma^2$ plus the natural logarithm $ln[f(x)=\underline{p}(x)=\underline{p}(d)$ of the a-priori probability f(x)=p(x)=p(d) upon deleting the additive constants" is not clear, appears to be verbose, includes an un-matched left square bracket, appears to suggest that using "f" instead of "p" serves no purpose, apparently introduces an extraneous variable "d" = "x" for no evident reason, and suggests there are multiple "additive constants" despite only having previously shown one so-called "additive constant" term; in lines 30-32, "It will be proven that the MX is equivalent to ML and that maximizing DX is equivalent to maximizing DM for decisioning, with an added improvement in BER performance using

DX" is unclear and appears to imply that decoding with the prior art ML reads on decoding with MX and decoding with the prior art DM reads on decoding with DX, except for a supposed "improvement in BER performance" which contradicts the stated equivalence.

On page 21: in lines 8-9, "equation DX=ln[f(x|y)] takes into account that the a-priori probability p(x)=f(x) is deleted" is not understood; in line 10, "constants" apparently should be "constant"; in line 11, "DM=ln(f{y|x)]" does not match parentheses properly and appears to reverse "x" with "y" as described above with regard to page 2; also in line 11, "additive constants are deleted" apparently should be "additive constant is deleted" as page 2, line 20 apparently shows only one so-called "additive constant" in line 20 thereof; in line 17, "our" is apparently inappropriate.

On page 23: in lines 4-6, "equation DX=ln[f(x|y)] takes into account that the a-priori probability p(x)=f(x) factor is deleted" is not understood; in line 6, "constants" apparently should be "constant".

On page 24: in lines 16-17, "events {s',y(k)}, {y(j>k)} are independent since the channel is memoryless" is apparently incorrect, unless the trellis is unconstrained, which implies y(k) and y(j>k) are *uncoded* received values; in lines 24-26, the equations $a_{k-1}(s') = p(s'|y(j<k))$, $b_k(s) = p(s|y(j>k))$ and $p_k(s,s') = p(s|s',y(k))$ are comparable to the equations $\alpha_{k-1}(s') = p(s',y(j<k))$, $\beta_k(s) = p(y(j>k)|s)$ and $\gamma_k(s,s') = p(s,y(k)|s')$ given for the prior art example on page 7, such that $a_{k-1}(s') = \alpha_{k-1}(s')$, except with the y(j<k)-term left-shifted over to the given ("conditioned on") side, and $p_k(s,s') = \gamma_k(s,s')$, except with the y(k)-term left-shifted over to the given side, however a comparison between $b_k(s)$ and

$\beta_k(s)$ shows that in addition to left-shifting the y(j>k)-term over to the given side, the "s" term has been right-shifted over to the non-given side (*i.e.* to the right side of the "|" from the left); it's here noted that (ref. U) Hagenauer *et al* (page 430, column 1, lines 14-16) teaches that the joint log-likelihood L(u,y) is equal to the conditioned log-likelihood L(u|y) since the probability P(y) term can be cancelled out, where y is the received value and u = "x" is the transmitted value, which anticipates applicant's left-shifting of the terms y(j<k), y(k) and y(j>k) over to the given side in the subject equations; right-shifting the "s" term in the prior art equation $\beta_k(s) = p(y(j>k)|s)$ to translate to the equation for $b_k(s) = p(s|y(j>k))$ appears to suggest that the so-called "backward recursion" is a forward recursion although this is not clear.

On page 32: in line 19, "ln[p(y(j>k-1)s')]" apparently should be "ln[p(y(j>k-1),s')]".

On page 35: line 10 is elliptical; in line 13, a period is apparently missing.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> **The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.**

4. Claims 1-3 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1: in line 11, "and which" apparently should be "and which comprises"; each recitation of "provide a means for ..." apparently should be preceded by a

semicolon; each recitation of "provide a means for ..." apparently should be "a means for ..."; each "means for" is not provided with a function required to create a means-plus-function limitation; all equations referred to in the claims should be directly incorporated into the claims for convenience; in lines 19-21, a "means for a factorization ..." is not described and the factorization is apparently only performed by the inventor; in lines 22-29, "means for the turbo decoding forward recursion equation" apparently should be "means for performing the turbo decoding forward recursion equation" however such a means is not shown; in lines (p.1) 30 to (p.2) 3, "means for the turbo decoding backward recursion equation" apparently should be "means for performing the turbo decoding backward recursion equation" however such a means is not shown; in lines (2)4-7, the "means for evaluating the natural logarithm ..." is apparently redundant with the "means for evaluating the natural logarithm ..." in lines (2)8-18 and thus apparently should be deleted; in lines (2)19-24, the function of the "means for the state transition probabilities" is not evident; in lines (2)25-28, the function of the "means for the natural logarithm of the state transition probability in the turbo decoding equations" is not evident and the means appears to be redundant with the means of lines (2)4-7 and (2)8-18 and thus apparently should be deleted; in lines (2)29-31, the function of the "means for the MAP turbo decoding algorithms" is not evident and is apparently otherwise redundant with preceding limitations and thus apparently should be deleted; in line (2)32, "paradym" apparently should be "paradigm"; in lines (2)32-(3)2, the function of the "means for a new a-posterior mathematical paradym ..." is not evident and is apparently otherwise redundant with preceding

limitations and thus apparently should be deleted; in lines (3)3-7, the function of the "means for a new a-posterior mathematical paradym ..." is not evident and is apparently otherwise redundant with preceding limitations and thus apparently should be deleted.

Similar observations apply to claims 2 and 3.

Further regarding claim 2: in line (4)27, "x(x)" apparently should be "x(k)"; in lines (5)6-7, "some of the performance improvements demonstrated" is considered indefinite.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> **(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.**

6. Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,815,515 to Dabiri.

Dabiri discloses generating a linearized branch metric formula by transforming the squared Euclidean distance, with the original squared Euclidean distance metric, M_c, expressed as (using codeword c = "x"), $M_c = (y-x)(y-x)^T$ which presumably also equals $|x-y|^2$ for a x as a single transmitted symbol. Dabiri discloses that squaring can be dispensed with by expanding $(y-x)(y-x)^T$ into $M_c = SUM_{i=1,n}\{y_i^2-2x_iy_i+x_i^2\} = SUM_{i=1,n}\{y_i^2\} + SUM_{i=1,n}\{-2x_iy_i\} + SUM_{i=1,n}\{x_i^2\}$, which presumably equals $-y^2/2\sigma^2 + Re(yx^*)/\sigma^2$ -

$|x^2|/2\sigma^2$ for each symbol after scaling by $-1/2\sigma^2$ and upon assuming x is real so that 2xy = $2Re(yx^*)$. Dabiri further discloses eliminating the $SUM_{i=1,n}\{y_i^2\}$ term because it is common to all metrics, thus leaving $-Re(yx^*)/\sigma^2 - |x^2|/2\sigma^2$ for each symbol after scaling by $-1/2\sigma^2$. Dabiri discloses using this simplified branch metric in a Viterbi decoder, not a turbo decoder. It would have been obvious to a person having ordinary skill in the art at the time the invention was made to apply Dabiri's teaching of branch metric equation simplification, which uses expansion of the terms squared and deletion of the y^2 term, to the prior art metric $|x-y|^2/2\sigma^2$ acknowledged by applicant, thus yielding the "new" branch metric $-Re(yx^*)/\sigma^2 - |x^2|/2\sigma^2$ for Viterbi decoding or turbo decoding.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stephen M. Baker whose telephone number is (571) 272-3814. The examiner can normally be reached on Monday-Friday (11:00 AM - 7:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Albert DeCady can be reached on (571) 272-3819. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Stephen M. Baker
Primary Examiner
Art Unit 2133

smb

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Notice of References Cited

Application/Control No.	Applicant(s)/Patent Under Reexamination	
10/772,597	VON DER EMBSE, URBAIN AL	
Examiner	Art Unit	Page 1 of 1
Stephen M. Baker	2133	

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,815,515	09-1998	Dabiri, Dariush	714/795
*	B	US-7,076,000	07-2006	Rodriguez, Michael J.	375/262
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
*	U	Hagenauer et al, "Iterative Decoding of Binary Block and Convolutional Codes", IEEE Transactions on Information Theory, Vol. 42, No. 2, March 1996, pp. 429-445.
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

OIPE IAP82
DEC 30 2006
PATENT & TRADEMARK OFFICE

APPLICATION NO. 10/772,597

INVENTION: Decisioning rules for turbo and convolutional decoding

INVENTORS: Urbain A. von der Embse

Currently amended DRAWINGS AND PERFORMANCE DATA